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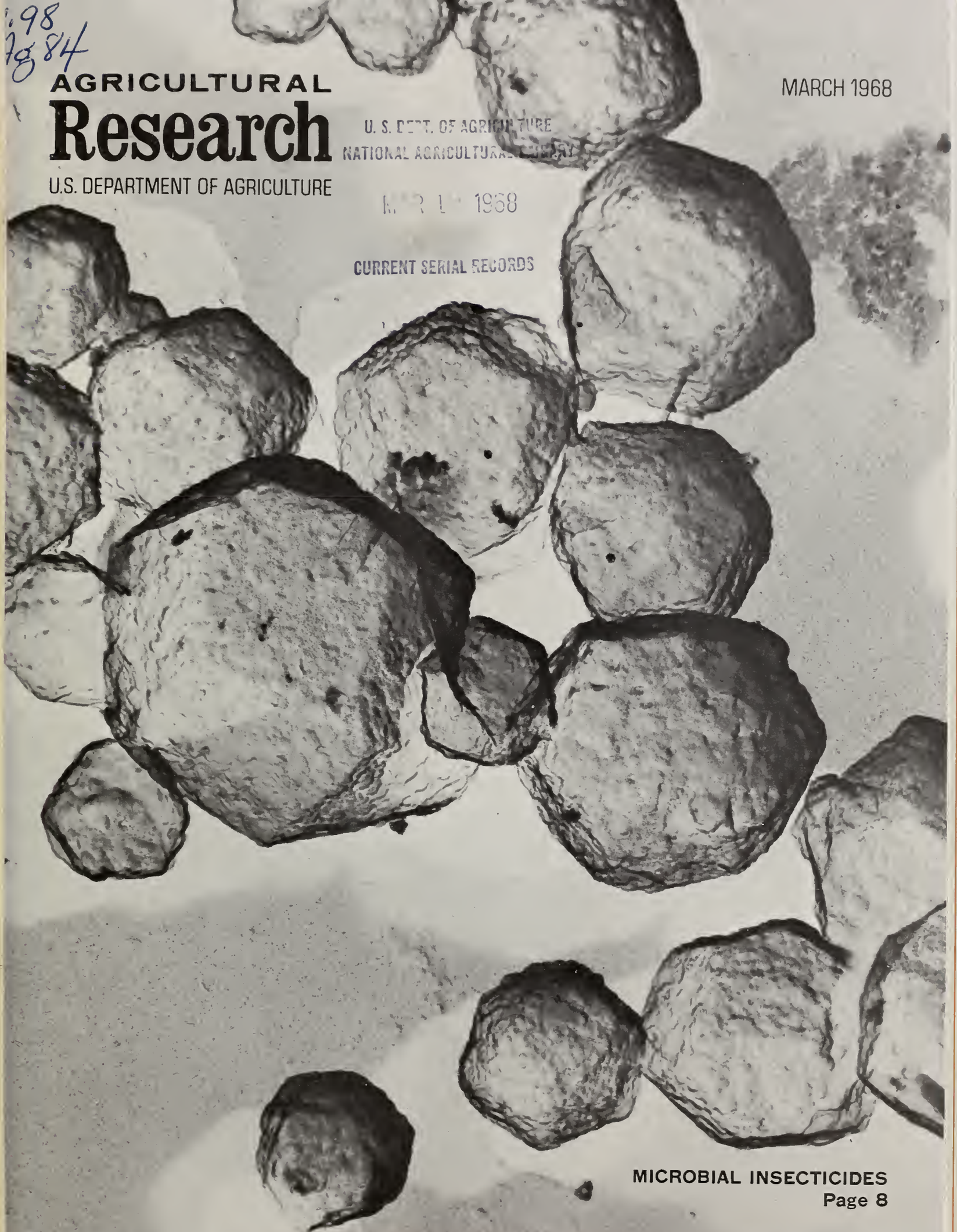

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Research

March 1968/Vol. 16, No. 9

The Future and Agricultural Research

How can an industrial nation such as ours—with the bulk of its labor force engaged in industry—continue to feed its people? How can our nation continue to meet the needs of a rapidly expanding population and have enough food to help the emerging nations with their food problems?

An efficient agriculture, backed up with research is the answer to both of these questions.

Because of agricultural research, today's farmers produce more efficiently and economically than ever before, passing on the savings to the consumer. This productivity has enabled the United States to provide food to emerging nations, where in some cases, a full belly has been the exception rather than the rule.

But that's today—the results we see come from research conducted years ago when agricultural scientists were anticipating the needs of a growing nation faced with a decrease in the numbers of people engaged in agriculture.

What about the future? The greatest challenge to research remains unchanged. How can the few who remain in agriculture meet U.S. needs for food, both at home and abroad?

Today's agricultural scientists are planning for the future by helping farmers to become more efficient—to cut their production costs; their labor needs. One approach—to meet our dwindling acres of farmland—is to help farmers make the wisest use of what they have. These scientists are working today to develop some of the principles on which the conservation of our soils, our water, and the wholesomeness of our environment must be based.

Today's research will mean a healthy and vigorous nation—a nation with a continuing capacity to reach out and help less fortunate nations meet their food needs and solve their agricultural problems.

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SCRAPIE RESEARCH MAY HELP IN STUDY OF HUMAN DISEASES

RESEARCH ON SCRAPIE—a centuries-old scourge of sheep—may provide leads for studying neurological diseases in humans.

In the many years that livestock scientists have studied scrapie, one of the most significant findings is a similarity of certain signs (symptoms) of scrapie in sheep and goats, encephalopathy (brain disease) in mink, as well as kuru in humans.

A fatal disease of the central nervous system, scrapie was first diagnosed in the United States in May 1947. The disease was introduced by imported sheep from Canada and Great Britain and is still an important threat to the U.S. sheep industry.

Scrapie has existed in Great Britain from the early 18th century and, since 1961, USDA Public Law 480 grants to institutions there have helped fund intensive studies on scrapie. The grantees, England's Agricultural Research Station at Compton and Scotland's Moredun Research Institute of Edinburgh, are internationally known centers of scrapie research.

Scrapie is an infectious and fatal disease of sheep and goats. Over the years scientists have noticed a similarity between signs of scrapie in sheep and symptoms of kuru in humans (BN–7333).

Characterized by its name, scrapie in sheep and goats causes compulsive rubbing against fixed objects; this results in patchy losses of fleece and skin damage, giving the diseased animal a ragged look. Other clinical signs are hypersensitivity, apprehension, trembling, lack of coordination, sometimes a drowsy syndrome, eventual collapse, and death. Also associated with the disease are microscopic vacuoles and other bilateral degenerative changes in the brains and spinal cords of affected animals.

The disease may exhibit extremely variable signs, and its nature has defied a half century of scientific research. The causative agent may be smaller than the smallest known virus, and, with the exception of the agents causing kuru in man and encephalopathy in mink, is unlike any other known disease organism.

One Public Law 480 British investigator says that studies on the nature and behavior of the scrapie agent have revealed so many bizarre characteristics that imagination is stretched to the utmost if one is to accept it as a living thing. For example, scientists have confirmed that scrapie has an extraordinary resistance to heat. It was discovered 20 years ago that scrapie tissue was still infective after being heated at 212° F. for 30 minutes. However, later work has shown that heating reduces infectivity by 95 percent. Autoclaving kills all of the agent as do some chemicals.

Scrapie can survive cycles of rapid thawing and freezing and has maintained its virulence after being kept in 10 percent formalin for over 2 years. It is resistant to ultraviolet light of

specific length absorbed by nucleic acid; yet it has the remarkable capacity to reproduce, which most scientists think requires nucleic acid. Laboratory culture tests comparing scrapie-diseased brain cells and normal brain cells showed that whereas normal cells died within 2 weeks, the scrapie cells continued to grow. This suggested the possibility that infected cells have a kind of abnormal growth—like cancer cells, for instance.

Scrapie poses another puzzling problem. Because the way it spreads from one sheep to another is not precisely known, scientific data do support the question: Is it hereditary or, if not, is it congenital? Research scientists have noticed the following relationships in observations made on infected premises. When both parents developed scrapie, the offspring almost always developed the disease. When the dam, but not the sire, had scrapie, about three-fourths of the offspring got the disease. When the sire, but not the dam, developed scrapie, about one-fourth of the offspring had the disease. When both parents were apparently free of scrapie, a smaller percent of their lambs developed the disease.

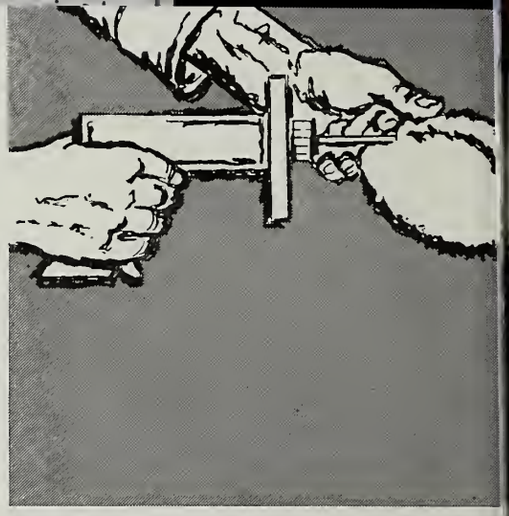
Although scrapie is primarily a disease of sheep and goats, it can be artificially transmitted to mice, rats, and hamsters, and conversely through these little animals back to goats and sheep. This behavior has helped researchers speed up their studies, because the incubation period in sheep may be from 4 months to 4 years or more. Unlike sheep, which seem to have varying genetic susceptibility to scrapie, goats and mice have a high predictable susceptibility and require less incubation time (goats—approximately 7 to 30 months, mice—approximately 4 to 12 months).

In trying to determine the nature of the scrapie infective agent, scientists have noticed its similarity to encephalitogenic factor, a small basic protein which causes allergic encephalomyelitis, a disease of the central nervous system. Unlike scrapie, this disease cannot be transferred in a series from species to species. Both scrapie and encephalitogenic factors have high resistance to ultrasonic treatment, drying, freezing, heat, organic solvents, and formalin; these are unusual properties in biological activity. In comparing the behavior similarities of both disease factors, some scientists have considered the possibility that the scrapie agent may also be a small protein or associated in some way with a small basic protein.

Other scientists prefer to think of the scrapie agent as an unusual virus and are directing their studies along the lines of viral research. Research workers in Scotland have demonstrated that scrapie can spread by contact from natural cases in sheep to both sheep and goats.

The most insidious thing about scrapie in animals and currently incurable neurological diseases in humans is the long incubation period. By the time signs or symptoms are detected, the infecting cells have already invaded the brain and the permanent damage is already done.

As scientific work, both here and abroad, continues to seek answers such as a diagnostic tool for the living animal long before signs appear; ARS with the help of State and local authorities is also maintaining an effective eradication program. Once a positive diagnosis has been made, the sire, dam, all of their progeny, and all progeny of the afflicted animal are automatically destroyed. Where the disease is entrenched in a flock, the entire flock, its progeny, the source flock, and their other progeny must be traced and destroyed.■



SCIENTISTS ARE attempting to find why growth stimulants markedly improve the performance of yearling steers so that they gain weight as rapidly as young calves.

That growth stimulants save cattle producers money is well established. Research dating back 15 years has shown repeatedly that gains go up about 15 percent and feed efficiency is improved 12 percent, if steers are properly treated with diethylstilbestrol, or stilbestrol for short. Treated cattle also produce meat with more protein and less fat.

Today, about 80 percent of the fed cattle marketed have been treated with stilbestrol. Despite the clear benefits from the treatment, scientists have known very little about how the growth stimulant acts.

Past digestion trials showed that stilbestrol treatment did not raise feed digestibility. There were indications that stilbestrol prevented feed energy from going into fat synthesis by shunting it toward protein synthesis. Feed efficiency and better growth then resulted because protein synthesis is a more efficient process than fat synthesis.

Scientists know little of how stilbestrol brings this change about, and ARS beef cattle nutritionist R. R. Oltjen thought he might find a clue by studying the effect of stilbestrol on the concentration of

Scientists study CATTLE GROWTH STIMULANT

the free amino acids in the blood, the building blocks from which protein is made up in body tissues.

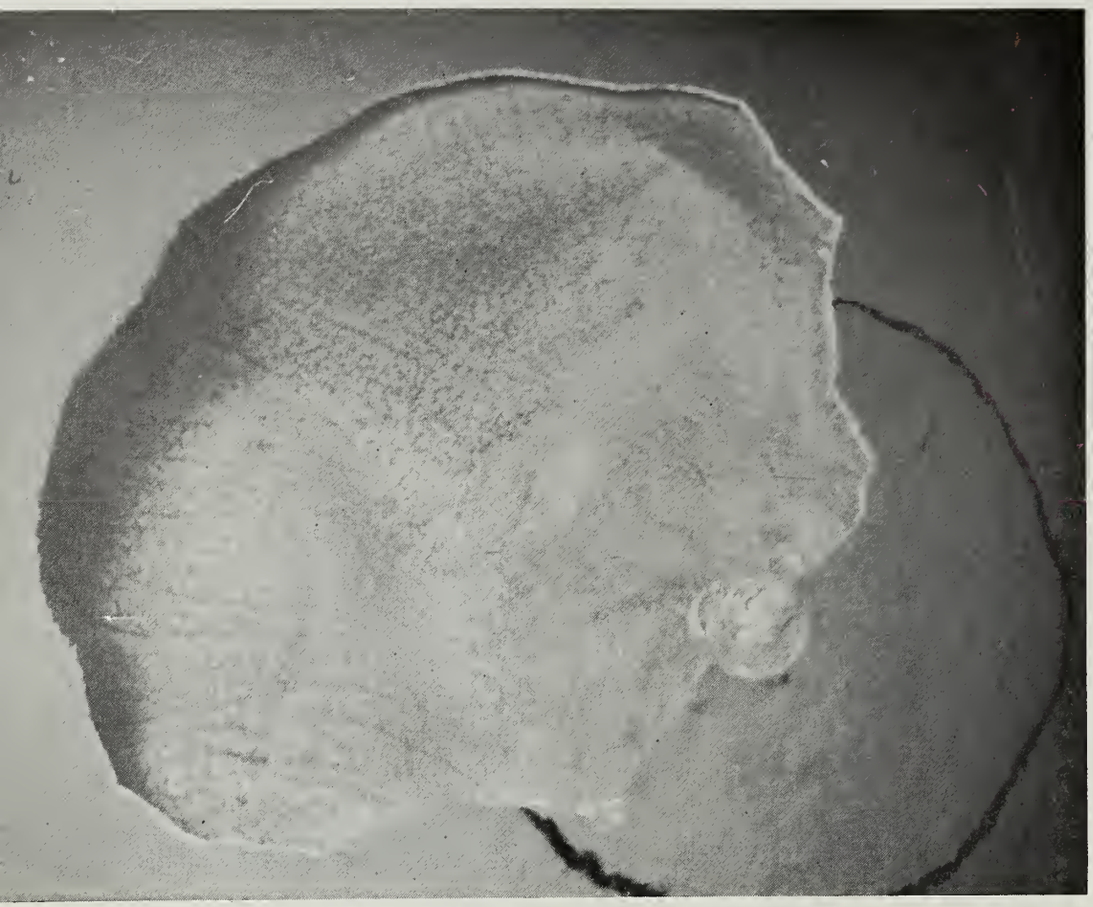
Oltjen found that the concentration of most of the essential amino acids and urea was lower in treated than in untreated steers. Other scientists studying rapidly growing calves have found similarly low amino acid and urea concentrations in the blood, suggesting that body tissues were absorbing these substances rapidly to build protein.

Two specific amino acids that followed the general trend of lower concentration in the blood of treated steers provided a further clue. Oltjen learned in earlier experiments not directly related to the stilbestrol study that serine and glycine levels were low when the efficiency of protein production was high, and vice versa. Low serine and glycine levels in stilbestrol-treated steers lend further evidence that these two nonessential amino acids are involved in growth processes, the scientist feels.

Most of the ARS studies on the action of stilbestrol were conducted with steers fed corn-finishing diets. But in one trial in which part of the steers were fed mainly wheat, the individual acids in the blood were affected somewhat differently in response to treatment with stilbestrol. This could mean that stilbestrol works differently with some rations than others, and the response may be altered depending on the amino acid content of the diet.

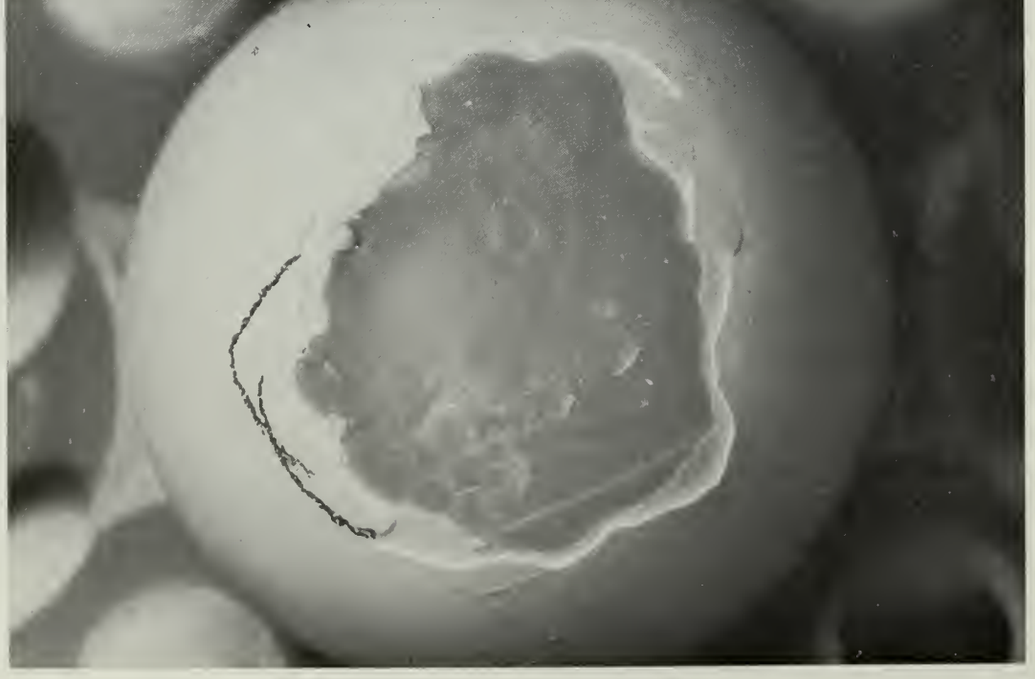
Knowledge of how stilbestrol works could help scientists develop new compounds which would be even more effective than stilbestrol. At present, stilbestrol doses have to be kept fairly low because higher levels tend to slightly lower carcass quality. A redesigned stilbestrol-like compound could help overcome this problem.■

Herdsman Douglas L. Thompson holds 10-month-old identical triplet bull calves. In future stilbesterol studies, scientists plan to compare growth rate and amino acid levels in the blood of one calf raised as an untreated bull, one as an untreated steer, and a third as a treated steer. Extremely rare, identical triplets occur only once in about a million births. They are most valuable for research because they minimize genetic interference with the effects of experimental treatment (ST–3340–7). Drawing shows capsule being implanted in ear of test steer; implant will last throughout finishing period.



The outer shell membrane is separated by slight air pressure from the shell itself, permitting researchers to examine inner shell surface for penetration by bacteria (PN–1608).

The thin, tissuelike inner shell membrane is separated by slight air pressure from the shell and outer membrane, permitting examination of the area between the two membranes (PN–1609).



Natural B
Protect E
Against S

AN INVISIBLE FILM on the shell of an egg is its first line of defense against salmonella bacteria, notorious food contaminants.

ARS research veterinarian J. E. Williams, who is working towards a means of reducing salmonella contamination of eggs, found that this film, called the bloom, seals the pores of the shell. Unsealed pores look like open gates to bacteria, which can pass through several abreast. Williams is based at the Southeast Poultry Research Laboratory, Athens, Ga.

Salmonella usually enter eggs when droppings or dirty litter are pressed against the shell during or shortly after lay. But the outer structures of the egg, Williams found, have four lines of defense. Besides the bloom, there is the shell itself and two inside membranes, which can best be seen at the blunt end where they separate to form the air bubble.

To check how fast bacteria penetrate each barrier, Williams designed an aluminum cylinder, five-eighths inch in diameter and open at both ends. After sealing one end of this

Barriers EGG Salmonella

Laboratory technicians Larry Dillard, front, and Robert Turnell take a sampling of the outer egg structures for penetration by salmonella organisms (PN–1610).

ARS research veterinarian J. E. Williams makes adjustments in equipment for monitoring the relative humidity level in cabinet used to fumigate the shells of fresh eggs with formaldehyde gas (PN–1611).

cylinder against the shell he can insert salmonella-infected manure into it, simulating natural contamination.

Following a set interval of incubation, shell and membranes are separated by blowing through small holes drilled to various depths so that the penetration to each level can be studied. Williams found that if the bloom is removed from the shell, bacteria can penetrate into the interior of a few eggs in less than an hour under the best conditions—100° F. and 60-percent humidity. In 3 hours, bacteria can penetrate 30 percent or more of the test eggs.

Williams is most specifically interested in *Salmonella typhimurium*, one of the most notorious species of the almost wholly harmful and extensive genus, *Salmonella*. This species causes digestive upsets in chickens, and, if transmitted to man, causes a combination of troubles called food poisoning.

No practical treatment can today kill *S. typhimurium* inside fresh market eggs. To prevent infection, market eggs should be kept as dry as possible and refrigerated promptly. Eggs broken for mass processing should be pasteurized, or—if used in cakes—baked at 350° for at least 30 minutes, Williams says.

Disinfection with formaldehyde gas, though not practical for market eggs, is highly recommended for hatching eggs. Williams is designing disinfecting cabinets for the job—the latest model equipped with controls that permit disinfecting 3,456 eggs every 35 minutes. Tests show that the hatch of treated eggs has been consistently as good as that of untreated eggs.■

Healthy almond moth larva (large caterpillar); larva, same age, infected with a nuclear polyhedrosis virus (actual size, three-eighths inch) (PN–1612).

MICROBIAL INSECTICIDES

Entomologists Discover New Disease Organisms Fatal to Insect Pests

SCIENTISTS HAVE discovered three new microbial diseases that may serve as biological weapons against insect pests of crops and stored foods.

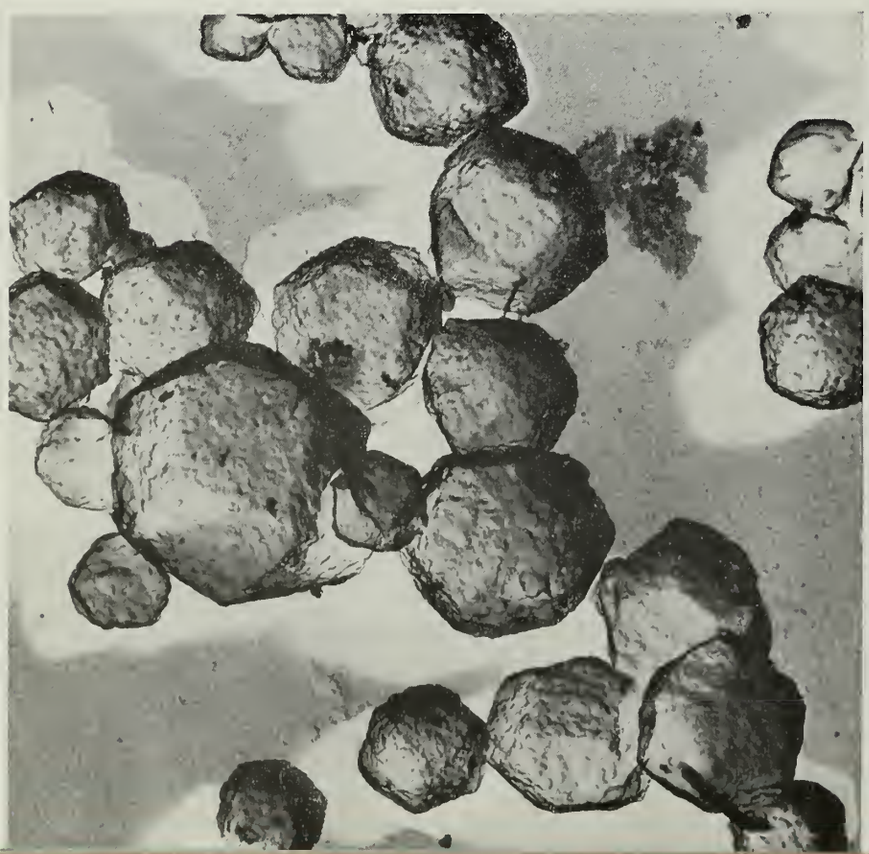
The diseases are all viruses, and add to a trend that will undoubtedly gain momentum with further research.

ARS entomologists J. R. Adams and J. V. Thompson, and biologist T. A. Wilcox, at Beltsville, Md., found that the new diseases are fatal to cabbage loopers, almond moths, and Indian meal moths.

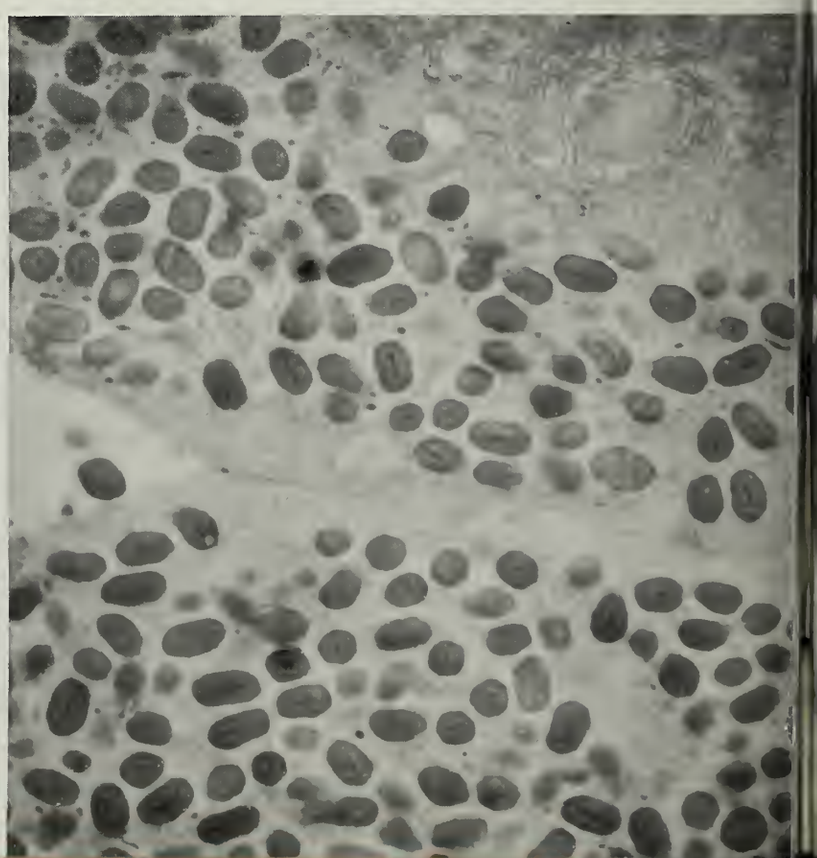
Cabbage loopers—pests of a wide variety of vegetable crops—are attacked by a new nuclear polyhedral virus that the loopers probably eat with their food. Within 3 days, the virus spreads from the gut to fat, nerve, and skin tissue.

In earlier research, scientists found a nuclear polyhedral virus that develops in the nucleus of infected cells of the cabbage looper and the corn earworm (AGR. RES. December

A fourth disease, not described in story, is caused by a new cytoplasmic polyhedral virus discovered in cabbage loopers. Coal-shaped polyhedra enclosing virus are magnified 14,850 times under electron microscope (PN–1613). (Cover is 37,100 times.)



Granulosis virus multiplying in skin tissue of diseased Indian-meal moth is revealed under electron microscope. Enlarged 16,350 times (PN–1614).



1963, p. 4). They learned that once a virus infects the cells of its host insect, the cells produce virus instead of carrying on their normal functions. During this process, virus particles cluster under a protective covering of protein and form a many-sided body called a polyhedron, which is tough and durable and can live in the soil for years.

Recently, the scientists also found a nuclear polyhedral virus which attacks almond moths, and a granulosis virus in Indian-meal moths sent for diagnosis by the ARS Stored-Product Insects Laboratory at Tifton, Ga. These viruses, depending on the insect species, multiply mainly in gut, fat, and skin tissue, and in the connective tissues of the muscle, brain, nerve cord, and reproductive organs.

The scientists are now studying conditions under which the organisms live within the insects' bodies. This information will help in developing ways of rearing the large quantities of organisms necessary to test the biological warfare approach. Basic information on the mode of attack by diseases is also being studied: the immediate goal is to pinpoint the sequence of events of viral disease within the first 2 days of infection.

Names for the diseases and their associated organisms have been postponed until further research identifies viruses attacking the insects; until then, scientists identify them by their broader type-classification.

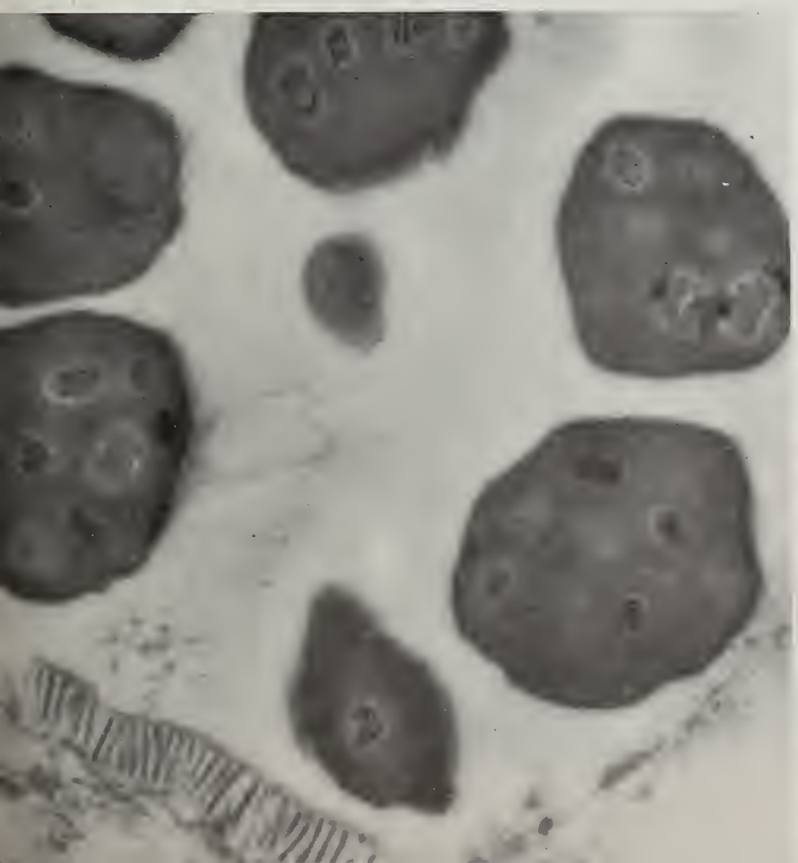
Advantages of microbiological control methods include:

- Elimination of residue problems.
- Tolerance of micro-organisms for chemical insecticides, permitting both agents to be combined in insect control.
- Apparent safety to crops, animals, and man.
- A self-perpetuating insect enemy in those cases where the disease spreads to succeeding generations. In tests with one disease, scientists found that infected insects perpetuated the disease by laying virus-contaminated eggs. (AGR. RES. December 1957, p. 7).

As knowledge of the new disease organisms' requirements increases, scientists may be able to rear masses of virus-diseased insects in the laboratory. ARS scientists have already developed a successful mass-rearing method for virus disease of cotton bollworms and tobacco budworms (AGR. RES. November 1964, p. 8). This may enable the scientists to proceed with this stage of the research at a faster rate.

Other scientists have identified virus diseases of more than 250 insect pests and have only scratched the surface. If man can employ but a fraction of the several thousand diseases that attack insects in the wild, he will have as great a choice of biological weapons as there are conventional insecticides today.■

Electron microscope reveals virus (rod-shaped particles) forming polyhedra in nuclei of skin tissue of almond moth. Enlarged 20,100 times (PN–1615).



Cross section from a coal-shaped nuclear polyhedral virus shows six bundles of virus rods in polyhedra. Round groups are end view of virus. Enlarged 72,650 times (PN–1616).

Imported DUCK VIRUS . . . quickly identified

DIAGNOSTIC ALERT, a nationwide program to quash accidentally imported diseases, has met a big challenge in duck virus enteritis.

In January 1967, poultry pathologist Louis Leibovitz of the State Duck Research Laboratory at Eastport, N.Y., tentatively diagnosed duck virus enteritis in sick birds brought for examination from a nearby duck farm. This disease, known to the industry as Dutch duck plague, had previously struck only in the Netherlands, Belgium, India, and China. Symptoms include swollen eyelids, diarrhea, and internal bleeding; death resulted in up to 50 percent of the cases.

State diagnosticians set Diagnostic Alert into action by sending specimens from the stricken ducks to the Plum Island Animal Disease Laboratory, the ARS facility on a small island in Long Island Sound devoted to studying and diagnosing exotic diseases. There, research veterinarian A. H. Dardiri confirmed the tentative diagnosis of duck virus enteritis and led a detailed followup study of the causal organism. (See article on next page.)

Meanwhile, the second stage of Diagnostic Alert went into action on a nationwide basis to determine the extent of spread of the invading disease virus. ARS's Animal Health Division and cooperating State veterinarians took blood samples from domestic ducks in the major duck-producing regions, and wildlife biologists took samples from wild birds.

Screening of about 3,000 blood samples failed to turn up duck virus enteritis infection anywhere except in New York, where the disease first appeared.

Over 1,700 screenings in New York itself showed infection was confined to a few commercial duck farms and some wild and domesticated waterfowl. A quarantine was established in this area on shipping duck eggs and ducklings except from approved inspected flocks.

The Nation's first line of defense against exotic disease is continual inspection of livestock and livestock products entering the country by agricultural and customs agents. Diagnostic Alert was set up as a second line of defense in 1953.

The program is a cooperative effort between ARS and practicing veterinarians and State and Federal veterinary officials.■

ARS disease control veterinarian S.S. Newcomb, collects a blood sample from a Pekin duck on Long Island, N.Y. Samples were taken from ducks in major duck-producing areas, while wildlife biologists took samples from wild birds in all-out second stage of Diagnostic Alert which was set up to determine extent of the invading disease virus (PN–1617).

Researchers Working on Dutch Duck Plague Vaccine

Develop Basic Procedure for Virus Study

A NEW BASIC procedure has been developed to study the virus which causes duck virus enteritis.

Based on a technique first developed for human polio virus research, the procedure involves grinding up embryonic tissues from partially hatched duck eggs, mixing them with a liquid, and allowing them to settle out against the sides of a 4-ounce bottle.

Virus is then added to the liquid, giving it a chance to infect the thin layer of duck embryo cells on the bottle. The liquid is drawn off and the bottles are incubated. Viruses attacking the tissue form tiny colonies, numbering from 25 to 100 per bottle. The colonies are called plaques, giving the test the name of "plaque assay."

Plaques permit scientists to prepare a tissue sample for study under an electron microscope, which requires a slice only 4 to 8 cell layers thick. Results from this study showed that duck virus enteritis is caused by a herpes virus, a DNA-virus that infects the cell nucleus of body tissues.

The process was developed by a group of scientists led by research veterinarian A. H. Dardiri, at ARS's Plum Island Disease Laboratory under the Diagnostic Alert program.

The plaques have also been helpful in showing that a positive blood test for duck virus enteritis means infection with that disease specifically. Antibodies appearing in the blood as a reaction to other virus diseases of birds, such as Newcastle disease and duck hepatitis, don't interfere with plaque formation by duck enteritis viruses.

Comparisons between plaques formed by the comparatively hot virus found in New York and a mild laboratory strain contributed by researchers in the Netherlands showed that antibodies produced against the two are identical. As a result blood testing can be done with the milder strain, which is easier for technicians to handle.

Plaques can be prepared in such a way that all the viruses in them are derived from a single virus. This enables scientists to work with a pure culture, so they can produce a specific vaccine. Exploitation of this possibility is well underway, and researchers hope to have a vaccine available for duck growers in the infected region early this year.■

TURKEYS do better in warmer pens

COOL TEMPERATURES in pens can make a marked difference in the profits a turkey grower realizes for a season's work.

Raising turkeys at pen temperatures as low as 55° F. contributes to high mortality rates and increases condemnation by processing plants. Turkeys also eat more feed, without corresponding weight gains.

These findings were made by ARS agricultural engineer W. A. Junilla, in cooperative research with animal disease and poultry scientists of the Minnesota Agricultural Experiment Station at St. Paul.

An almost across-the-board improvement resulted at a pen temperature of 66° F., compared to a 55° F. pen temperature.

At the warmer temperature, there were fewer processing plant condemnations, lower mortality, a lower feed conversion ratio, and higher weight gains. Based on these findings, specifications for turkey housing and environmental control have been developed to reduce condemnations and aid in keeping disease-free flocks isolated from outside contamination.

This development is of great economic importance in Minnesota, leading U.S. turkey-producing State, but turkey producers in a similar environment will also benefit.■

RESEARCH CONTINUES on CSM,

Mainstay of Food for Freedom

A FLOUR-LIKE product called CSM developed by ARS scientists, is a mainstay of the Food for Freedom program.

Close to 300 million pounds of the corn-soy-milk food blend have already been shipped to more than 90 developing countries where there is a desperate need for proteins. Designed especially for recently weaned infants and preschool children, the formulated food consisting of processed cornmeal (68%), soybean flour (25%), and nonfat dry milk (5%), to which minerals and vitamins (2%) have been added, can be used by any age group.

Blended Food Product—Formula No. 2 (the technical name for CSM) is a complete precooked food which requires only a minimum of preparation. The cost is relatively low—approximately 7.5 cents per pound packaged and delivered to ocean ports—and industry has been able to produce the formula in large amounts.

Three and one-half ounces, when made into a gruel or porridge, will supply a child with one-third to one-half or more of the necessary daily nutrients, except for ascorbic acid (vitamin C), during a period in his life when lack of proper food can irreversibly harm both body and mind. When children are reached in time they respond rapidly to the improved diet.

Although the product has been well received, USDA has not stopped with development of the CSM formula. Scientists from the Department's Consumer and Marketing Service check each shipment to be sure the product is uniform from batch to batch. They make sure the product meets specifications for protein, fat content, texture and cooked consistency.

Of great importance are the checks for odor and flavor. ARS food specialists prepare samples of soups, beverages, gruels, and porridges and test for flavor and other characteristics that combine to make the blend acceptable. Experience shows that even hungry people will not eat a food if the taste, appearance, texture, or odor offends them—and each country has its own standards. Food habits are hard to change, often reflecting centuries-old religious and social beliefs and superstitions.

Besides developing the formula for CSM and the specifications for the product, ARS scientists have done research on different methods of precooking cornmeal, the major ingredient. This research has contributed to increased production, thereby making the product more available to the government. The revised specifications assure uniformity regardless of the method by which the blend is produced.

All the while, efforts to develop new uses for CSM continue along with experiments designed to further perfect the formula. Research also continues on composition of the blend (fat content, non-fat dry milk and inclusion of sucrose or dextrose) as it relates to moisture content and temperature. Both are very important to "keeping quality" of the product during storage and distribution, and to flavor and texture of the product when it is consumed.■

CALCIUM Helps Prevent Fungus in Peanuts

CALCIUM AIDS in the healthy development of children and young peanuts. Scientists have now obtained evidence that calcium also may protect peanuts against a pod-rotting fungus.

The fungus, a species of *Pythium*, attacks in-soil peanut fruit. On an experimental research plot at the Tidewater Research Station, Holland, Va., almost one-third of the pods of the Virginia Bunch 46–2 variety of peanuts not specifically treated were decayed by this fungus in 1961, about 5 weeks before harvest time.

Experiments by ARS plant pathologist K. H. Garren first indicated that unusually high rates of gypsum, a calcium-rich material, may help block the fungus attack on developing peanut fruits.

More recently, Garren and D. L. Hallock, agronomist with the Virginia Polytechnic Institute, obtained additional evidence in 3 years of tests showing that calcium may be the beneficial agent. Both work at the Tidewater Research Station.

Because calcium is not readily transported from the main part of the plant to the pod tissue, planters frequently apply 440 to 880 pounds per acre of gypsum. Calcium sulfate, or gypsum, is more soluble than other calcium sources, and does not appreciably change the acidity of the soil.

The researchers applied up to 2,720 pounds per acre gypsum to a loamy, fine sand soil at the time plants were in the early bloom stage.

One or 2 weeks before normal digging time, they examined the treated plants. The percentage and number of fungus-rotted pods on these plants were substantially lower, on the average, than on the normally fertilized plants. The extra calcium may have increased resistance to the fungus and promoted formation of dormant, rather than active, stages of *Pythium*.

The increased application of gypsum also resulted in higher peanut yields, because fewer fruits rotted. Rotted and semi-rotted fruit is often separated from the rest of the crop during digging and picking. The treated plants produced a larger percentage of sound mature seeds and a decreased percentage of externally damaged seeds.

Average seed and pod size were smaller, however, because more of the slightly immature fruit, with small seeds, escaped rot and so remained in the count.

Experiments showed that the best rate of gypsum application for pod-rot suppression and optimal fruit yield is about 1,800 pounds per acre. Fungus attack was significantly reduced when pods contained approximately 0.20 percent or more calcium.■

LODGE-RESISTANT MAIZE Being Developed for Nigeria

NIGERIAN FARMERS may soon be growing tough-rooted and lodge-resistant maize because an ARS scientist stationed in Nigeria has developed a method of selecting plants for stronger roots.

Root lodging of maize (corn) is a serious problem in Nigeria. Major causes are loose sandy soil and strong winds that accompany rainstorms. Lodging reduces yields because rodents eat many ears before they can be harvested.

The method developed by plant pathologist Jeweus Craig is part of a program to improve maize production in Nigeria. In the program, ARS scientists are working cooperatively with the Agency for International Development and the University of Ibadan, Ibadan, Nigeria.

Using an improved maize strain, 011, developed in the program, Craig worked to select for superior lodge resistance. Since winds and rainstorms are unpredictable, he built a machine to measure the resistance of individual plants to vertical pull.

The machine consists of a 2- by 4-inch timber fitted to an axis to form a level. A 200-pound capacity spring balance, secured to the lever and attached to the maize plant by a rope, measures resistance to uprooting. Root strength rating is determined by the ratio of ear height to the pounds of pull necessary to uproot the plant.

Craig put 011 through two cycles of mass selection for root strength. The first year, he planted the 011 in plots, harvested the ears, then tested the root strength of each plant with the machine. Seed from plants with the highest resistance to uprooting was saved to be planted for the next selection cycle.

After the first selection cycle, root strength was 14 percent higher than for the original 011. By the second cycle, root strength had increased by 34 percent over the original 011 strain. Craig expects that further cycles of selection will show continued improvement.■

New shield prevents CLOGGED DRAIN TILES

A NEW ANTI-SEDIMENTATION shield may end clogging, a problem in many subsurface drain tiles.

Subsurface drainage is converting over 300,000 acres of wet and soggy and potentially saline land into valuable cropland each year in the United States. In irrigated farming areas, such as the arid Southwest, drainage is necessary to remove excess irrigation water and prevent salt buildup in the soil. Elsewhere, as in the Corn Belt, drain tiles remove excess water from the soil that would otherwise inhibit crop growth.

Many of the drains being installed today work satisfactorily, but this is due largely to cohesiveness of the soil. In noncohesive soils, such as silts and very fine sands, soil may clog drains, greatly reducing their effectiveness.

The ARS-developed shield that may end such clogging covers the top half or more of the drain tile. For smooth drain tile—most conventional tile is smooth—the shield is corrugated, with ridges and valleys running across the tile. When the shield rests on the drain tile, the underside creates evenly spaced channels leading up the sides to the top of the tile where holes have been made.

Drainage water percolating down through the soil must flow past the top of the tile, then flow upward under the shield and through the channels to get into the holes on top of the tile. When water flows upward into the channels, soil particles are held in place by gravity.

The number of upflow channels along a section of drain tile, the area of the channels, and shape of the channel entrances may all vary as long as basic design conditions are met. Channel entrances must be at a point lower than holes in the pipes, and there must be enough cross-sectional area in the channels so that the velocity of water flow does not move the soil particles into the channels.

The researchers say that different materials can be used to make the shield. They used a semi-rigid, corrugated plastic shield on smooth drain tile and a smooth, semi-rigid plastic shield on corrugated tile. In each case the plastic shield was shaped over the tile but was rigid enough to keep from collapsing and closing the channels.

For the corrugated, plastic tile, holes were made in the depressions between the corrugations. The smooth cover left the depressions open, creating channels leading to the holes in the top of the tile.

The anti-sedimentation shield was developed by research agricultural engineers L. S. Willardson, J. L. Fouss, and R. C. Reeve, and soil scientist N. R. Fausey. Initial tests were at Columbus, Ohio, in the Corn Belt region, where over 60 percent of agricultural drainage systems are found.

Besides keeping drains sediment-free, the shield also provides minimum resistance to water flowing into the drains. It does not function as a filter and will not lose its effectiveness with time if installed properly.

Customarily, soil particles are prevented from entering drain tiles by surrounding the tiles with gravel or some other natural material. Recently, manufactured materials—fiberglass and stabilized cinders, for example—have been used. These materials, however, act much like a filter, and they may eventually become clogged with the material they remove from the water.

Before drain tiles using the anti-sedimentation shield are installed in any new areas, some evaluations must be made by specialists to insure proper operation. As with conventional drain systems, efficient operation will be more difficult to attain in silts and very fine sands.■

AGRISEARCH NOTES

ARS agronomist C. R. Adair compares seedling height of different rice varieties grown at 60° F. in the milk can cooler (ST–3278–5).

Cold Resistant Rice Plants

Researchers are using milk can coolers to solve a problem facing California rice growers along the Feather River.

The problem: icy-cold irrigating water soon to flow from the Oroville Dam (AGR. RES., July 1962, p. 13). Because the average temperature of river water below the dam will drop below the optimum for irrigating commonly grown Caloro rice, there is an imminent need for an efficient method of testing the cold resistance of alternate varieties. C. R. Adair, ARS agronomist at Beltsville, Md., cooperating with Californa ARS researchers, has found a method capable of testing the cold water tolerances of 600 varieties per year, using growth rate as the criterion.

Adair submerges pregerminated seeds of different varieties of rice in a commercial milk can cooler. After 26 days he measures seedling growth to determine which varieties have grown tallest. He has tested some varieties that will grow 160 percent taller in 4 weeks than Caloro, when grown at 60° F. These varieties are being used to breed new cold resistant varieties suitable for California cultivation.

The sun doesn't warm water standing deep in glacial-fed dam reservoirs. The icy water that is drained from the bottom of the dam warms less than 2° per 10 to 25 miles as it flows through canals and river beds and onto irrigated fields.

Cold water slows the growth rate of most crops by affecting the temperature of soil around the roots. Cold water has been especially serious for rice growers, however, because the soil in rice fields is submerged during the growing season.

In 1945, when the Shasta Dam was completed, rice growers along the Sacramento River 100 miles below the dam reported that rice plants on 5 percent of their acreage did not mature because water temperature dropped from 61° to about 44°. Scientists fear an even more serious crop loss will develop in the Feather River Valley, where water temperature will take a similar dive after the dam begins operating, unless cold-resistant varieties are cultivated.

Controlling Pansy Fungus

The timely application of fungicides can control a serious disease that attacks pansy plants.

The disease, *Centrospora acerina*, which commonly occurs in cooler climates, including the northern United States and Canada, has now been found for the first time in the southern United States.

Pansies are a major spring bedding plant in this country, providing large areas of color. New hybrids, that extend the blooming period far into the summer, have increased the popularity of pansies and their commercial production is on the increase.

ARS scientists D. L. Gill and T. J. Ratcliffe, in tests at Tifton, Ga., found that infection did not occur, or occurred very lightly, on plants sprayed first with tribasic copper sulfate and then with a spore suspension of the fungus. The spores used to infect the test plants were grown on tomato-vegeable-juice-agar cultures. Tribasic copper sulfate has been approved for use on non-food plants.

The fungus of the *Centrospora* disease attacks leaves, petioles, flowers, and seed pods of pansies. It appears first as a small, blue-black speck that enlarges into a patch with a brown center encircled by a dark ring. The under surface of the infected area appears wet and greasy.

To determine the prevalence of the disease in Georgia, the establishments of pansy producers in all parts of the State were checked. The fungus was found in the plant beds of 5 of 12 producers.

All 5 of the producers with infected seed beds had obtained seeds from the same source. This, plus the fact that most of the infected seed beds either had been fumigated with methyl bromide before planting or contained soil that had never been planted with pansies, led the investigators to suspect that the disease could be transmitted by seed. This has not been confirmed, however, the scientists said.■

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AGRISEARCH NOTES

Larvae Survive Long Storage

Larvae of the soybean cyst nematode can survive storage in seed bags for 22 months and perhaps longer, retaining their ability to spread infestations.

In experiments conducted at Jackson, Tenn., ARS nematologist J. M. Epps found that cysts with viable larvae of the nematode *Heterodera glycines* survive drying and storage much longer than scientists had previously reported.

Because the larvae survive in cysts for such long periods, they could be carried to many different areas in seed bags, loose, on seed, or in irregular accumulations of soil called "peds."

Epps placed cysts from the field in small muslin bags at the center of commercial bags of seed. The seed bags were then stored under conditions ranging from good to poor. One was stored in a greenhouse, one in an air-conditioned laboratory, and one in a closed shed. Temperature and humidity varied greatly from building to building.

Each month Epps removed a muslin bag from each location, and 50 cysts were examined to see if they contained viable larvae. After 22 months, when the cysts had all been tested, they still contained larvae capable of infecting plants.

Physicist McClean George places a test specimen in the new cartridge-type holder for the Monsanto Wrinkle Recovery Tester (PN–1618).

Because the larvae survive from harvest until planting the following year—and even longer, Epps believes—it is reasonable to expect that this nematode can be carried to new sites with planting seed.

Scientists have long observed that nematodes move with irrigation water, and possibly the movement of water in the Mississippi River Basin helps spread the pest. The nematode, however, has spread to areas as far from the Mississippi River Basin as Florida.

Epps is now conducting experiments to determine how seed lots can be effectively sterilized.

Cartridge-Type Holder Gives Testing Uniformity

A special cartridge-type specimen holder has been developed for evaluating wash-wear and durable press cotton fabrics with the Monsanto Wrinkle Recovery Tester.

The new holder has two important advantages over present holders: it eliminates excessive handling by the operator and it provides for greater uniformity in technique among operators.

To evaluate experimental wash-wear and durable press treatments, small carefully creased samples of treated fabrics are placed in the tester which shows how quickly and nearly the fabric returns to the flat state.

Inventors of the new holder are physicists McLean George and Anthony R. Markezich and engineering technician Herbert R. Copeland, of the ARS Southern utilization research laboratory at New Orleans.

CAUTION: In using pesticides discussed in this publication, follow directions and heed precautions on pesticide labels. Be particularly careful where there is danger to wildlife or possible contamination of water supplies.

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